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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/964,910	09/27/2001	Kiyoshi Yamaura	112857-301	3249

29175 7590 07/12/2005

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EXAMINER	
YUAN, DAH WEI D	

ART UNIT	PAPER NUMBER
1745	

DATE MAILED: 07/12/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/964,910	YAMAURA ET AL.	
	Examiner	Art Unit	
	Dah-Wei D. Yuan	1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 June 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *8,10-14 and 16-32* is/are pending in the application.

4a) Of the above claim(s) *27-32* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *8,10-14 and 16-26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *27 September 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

GAS DIFFUSION ELECTRODE AND FUEL CELL INCLUDING SAME

Examiner: Yuan S.N. 09/964,910 Art Unit: 1745 July 11, 2005

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on June 30, 2005 has been entered. Claims 8,14,21 have been amended.

2. The text of those sections of Title 35, U.S.C. code not included in this action can be found in the prior Office Action issued on March 29, 2005.

Claim Rejections - 35 USC § 112

3. The claim rejections under 35 U.S.C. 112, first paragraph, on claims 8,10-14,16-26 are withdrawn, because the independent claims 8,14,21 have been amended.

Claim Rejections - 35 USC § 103

4. The claim rejections under 35 U.S.C. 103(a) as unpatentable over Hager et al., Fischer et al. and Kordesch et al. on claims 8,11,14,16,21,23 are withdrawn, because the independent claims 8,14,21 have been amended.

5. Claims 8,10,14,16-18,20,21,26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fleckner et al. (US 6,589,682 B1) in view of Ren et al. (US 2003/0203139 A1) as evidenced by Oyama et al. (US 2003/0048057 A1).

With respect to claims 8,10, Fleckner et al. teach a fuel cell comprising two gas diffusion layers (100,102) (gas diffusion electrode), which comprises carbon nanotubes to distribute reactant gas over the catalyst sites. Fleckner et al. further teach the nanotubes can be processed by a variety of methods including vapor deposition techniques. One in-situ technique which can advantageously be used is chemical vapor deposition of various hydrocarbon compounds such as methane at controlled locations on a substrate using patterned catalytic islands. This combined synthesis and microfabrication technique allows a large number of ohmically contacted nanotube devices of controllable length to be placed on a single substrate. See Column 7, Lines 8-36; Column 9, Lines 32-46; Figures 6-8. It is well known that carbon nanotube is a fibrous carbon material as evidenced by Oyama et al. See Paragraph 4.

The disclosure of Fleckner et al. differs from Applicant's claims in that Fleckner et al. do not specifically disclose the thickness of the fibrous carbonaceous material. However, it would have been obvious to one of ordinary skill in the art to synthesize the nanotube for use as a gas diffusion electrode in a fuel cell to a thickness of about 2 to about 4 micrometers, because Fleckner et al. teach the length of the nanotube is controllable by using the combined chemical vapor deposition and microfabrication technique.

Fleckner et al. further teach one in situ technique that can advantageously be used to fabricate the carbon nanotubes is chemical vapor deposition of various hydrocarbon compounds.

See Column 9, Lines 39-43. Ren et al. teach the fabrication of carbon nanotubes by chemical vapor deposition. Plasma intensity, carbon source gas to catalyst gas ratio and their flow rate, catalyst film thickness, and temperature of chemical vapor deposition affect the lengths, diameters, density, and uniformity of the carbon nanotubes. Typically, the carbon nanotubes range from 4 to 500 nm in diameter and 0.1 to 50 μm in length depending on growth conditions. See Abstract. Therefore, it would have been within the skill of the ordinary artisan to vary the growth condition and processing time of the nanotubes to yield nanotubes of thickness ranging from about 2 to about 4 μm. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art.* In re Boesch, CCPA 1980, 617 F.2d 272, 205 USPQ215.

With respect to claims 14,16, Fleckner et al. teach a fuel cell comprising a Nafion membrane (92) (a perfluorosulfonate ionomer) disposed between two gas diffusion electrodes (100,102). The gas diffusion electrodes further comprise carbon nanotubes. See Column 7, Lines 8-36; Figures 6-8.

With respect to claims 17,18, Fleckner et al. teach the fuel cell further comprising a Pt/carbon ink by mixing 20 wt.% platinum on Vulcan XC-72R carbon with Nafion solution. See Column 8, Lines 39-58.

With respect to claim 20, the fuel is supplied through conduits (41) to the gas diffusion electrode (56) on the fuel side of the fuel cell whereas oxygen is supplied through conduits (43) to the gas diffusion electrode (54) on the oxidant side of the fuel cell. See Figure 2, Column 5, Lines 40-67.

With respect to claim 21, Fleckner et al. teach a fuel cell comprising a Nafion membrane (92) (a perfluorosulfonate ionomer) and two gas diffusion electrodes (100,102). The gas diffusion electrodes further comprise carbon nanotubes. See Column 7, Lines 8-36; Figures 6-8.

With respect to claim 26, Fleckner et al. teach the fuel cell further comprising a Pt/carbon ink by mixing 20 wt.% platinum on Vulcan XC-72R carbon with Nafion solution. See Column 8, Lines 39-58.

6. Claims 11-13,19,22-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fleckner et al. and Ren et al. as applied to claims 8,10,14,16-18,20,21,26 above, and further in view of Hager et al. (US 6,013,371).

With respect to claims 11,12,23, Fleckner et al. disclose gas diffusion electrodes comprising carbon nanotube material as described above in Paragraph 6. However, Fleckner et al. do not teach the fibrous carbonaceous material comprising a mixture of carbon nanotubes and vapor grown carbon fibers. Hager et al. teach the addition of vapor grown carbon fibers can enhance the mechanical performance of the resulting carbon–carbon composite. See Column 3, Line 62 to Column 4, Line 5. Therefore, it would have been obvious to one of ordinary skill in the art to use of the mixture of carbon nanotube and vapor grown carbon fibers on the gas diffusion electrode of Fleckner et al., because Hager et al. teach the addition of VGCF can improve mechanical performance of the components.

With respect to claim 22, Fleckner et al. disclose a fuel cell comprising a proton conductor disposed between a first electrode and a second electrode wherein both electrodes

comprise a carbon nanotube material as described above in paragraph 9. However, Fleckner et al. do not teach the fibrous carbonaceous material comprising a mixture of carbon nanotubes and vapor grown carbon fibers. Hager et al. teach the addition of vapor grown carbon fibers can enhance the mechanical performance of resulting carbon–carbon composite. See Column 3, Line 62 to Column 4, Line 5. Therefore, it would have been obvious to one of ordinary skill in the art to use of the mixture of carbon nanotube and vapor grown carbon fibers on the gas diffusion electrode of Fleckner et al., because Hager et al. teach the addition of VGCF can improve mechanical performance of the components.

With respect to claims 13,19,24,25, Fleckner et al. and Hager et al. disclose applicant's invention essentially as claimed, with the exception that the ratio between the carbon nanotube and the vapor grown carbon fibers in the mixture is not discussed. However, Hager et al. recognize the incorporation of vapor grown carbon fibers into the composite can provide a reinforcing effect on the mechanical property of the material. See Column 3, Lines 8-12; Column 3, Line 62 to Column 4, Line 5. Therefore, it would have been within the skill of the ordinary artisan to adjust the relative amounts of carbon nanotube and vapor grown carbon fiber in the composite depending on the strength requirement of the composite electrode in the fuel cell. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art.* In re Boesch, CCPA 1980, 617 F.2d 272, 205 USPQ215.

Response to Arguments

7. Applicant's arguments filed on June 30, 2005 have been fully considered but they are not persuasive.

Applicant's principle arguments are

Fleckner doe not disclose or suggest that the gas diffusion electrode composed of a carbonaceous material can be directly formed on the proton conductor material, such as an electrolyte film;

In response to Applicant's arguments, please consider the following comments.

The claimed novelty is not stated in the independent claims, and thus the combination of Fleckner and Ren references meets all the limitations of the claims as described above;

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dah-Wei D. Yuan whose telephone number is (571) 272-1295. The examiner can normally be reached on Monday-Friday (8:00-5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan, can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished

applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Dah-Wei D. Yuan
July 11, 2005

DAH-WEI YUAN
PRIMARY EXAMINER